ADVANCED REACTOR, FUEL CYCLE, AND ENERGY PRODUCTS WORKSHOP FOR UNIVERSITIES

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Generation IV Advanced Reactors

Energy Conversion

Sandia National Labs

Workshop for Universities
Hilton Hotel, Gaithersburg, MD
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Gen IV Energy Conversion
FY07 Work Scope

- Objectives: *Develop advanced power conversion systems for Gen IV reactors that have potential to reduce the cost of nuclear generated electricity - higher efficiency, lower capital cost*

- FY07 focus is on power conversion systems for reactor systems with outlet temperatures in the range of 500 to 700°C. (SFR, LFR, GFR, MSR).
  - Supercritical CO2 power conversion systems
  - PCS design and analysis studies
  - Control strategies for coupling to Gen IV reactors
  - Small scale experiments to confirm models

- Other Energy Conversion research areas include:
  - Options studies for high temperature He Brayton cycles for NGNP (~950°C).
  - Advanced heat transport studies for intermediate heat exchangers and intermediate heat transfer loop options

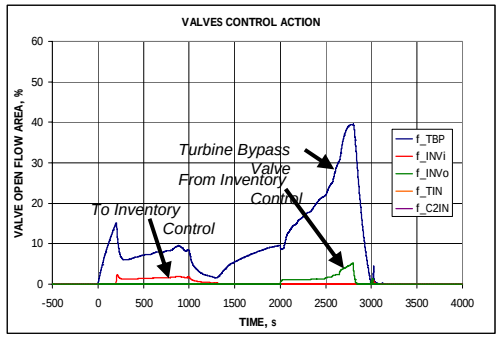
Gen IV Energy Conversion
FY06 Accomplishments

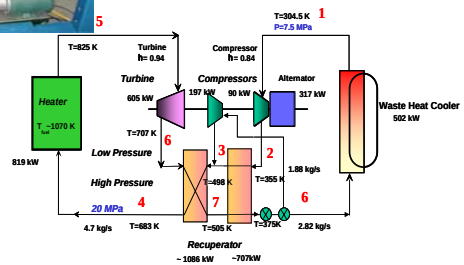
- ***S-CO2 Cycle Development***
  - *System design for 20 to 1200 MWe (MIT, ANL)*
  - *Control strategies - model development and simulation) (GASSPASS CO2, ANL Plant Dynamics, SNL Dynamics Response Model)*

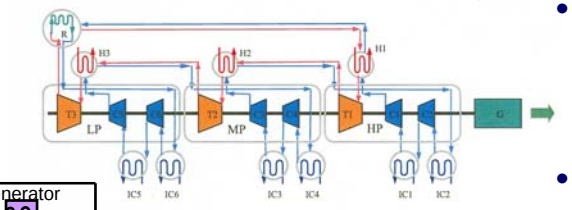
- ***S-CO2 Heat Transfer Exps***
  - *ANL PCHE loop -S-CO2 heat transfer models*

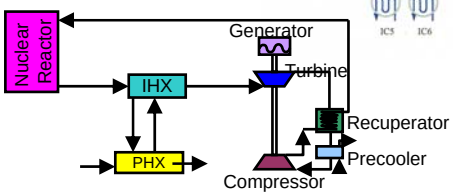
- ***Small Scale S-CO2 system design (Industry)***
  - *Provide data for compression near CO2 critical point, and system response*

- ***S-CO2 Materials (MIT, LANL)***
  - *CO2 compatibility studies – MIT loop*









- ***High temperature Helium Brayton cycles (SNL,UCB)***
  - *Efficiency/cost trade off for IH/IC systems*

- ***Advanced Heat Transport (INL)***
  - *Intermediate loop design- He, liquid salt, performance - cost analysis*

- ***Brayton cycle experiments, analysis (SNL)***
  - *CBC transient, SS experiments for model development*

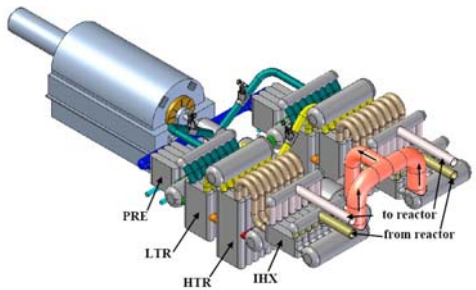
Gen IV Energy Conversion FY07 Work in Progress

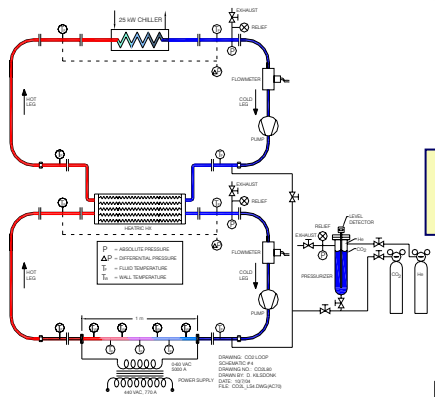
S-CO2 - intermediate temperature reactors (500-700 C)

- *FY07 tasks - demonstrate key technical features of S-CO2*
- *Key issues – compression near critical point, control strategy for split flow cycle*

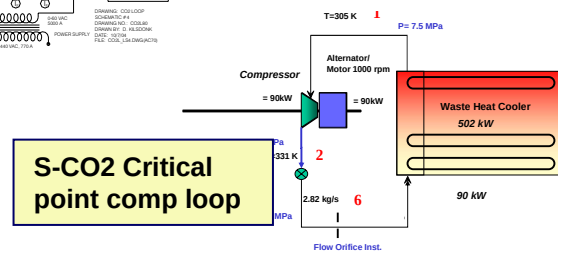
FY07 Task Areas

1. *S-CO2 system design (MIT)*
2. *S-CO2 control analysis (ANL, MIT)*
3. *PCHE heat transfer experiments (ANL)*
4. *S-CO2 materials testing (MIT, LANL)*
5. *Initiate construction of small scale S-CO2 compression exps and (~ MW) class split flow Brayton cycle system (SNL, Industry)*





S-CO2 gas – gas heat transfer loop

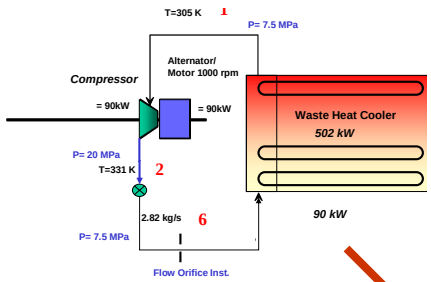


S-CO2 Critical point comp loop

Gen IV Energy Conversion PLANS FOR FY08-09

- **FY2007**
- Power conversion cycle analyses and system design -- address viability issues and performance potential for S-CO2 Brayton cycles.

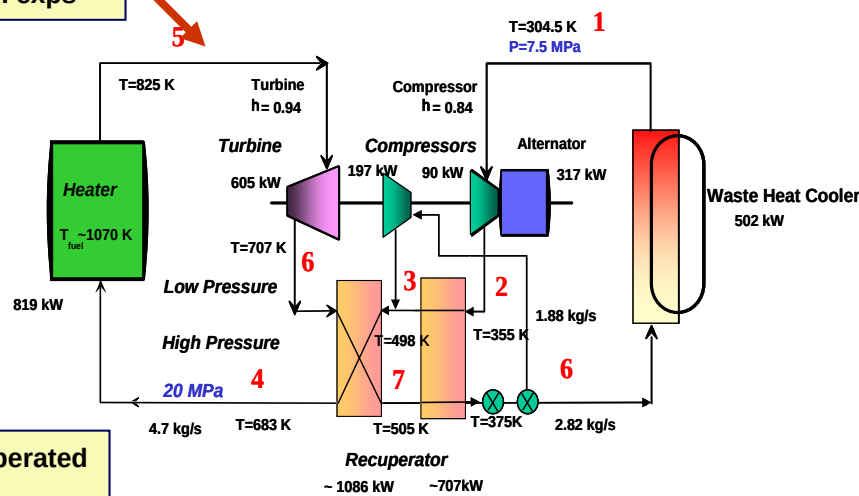
- **FY2008–2010**
- Laboratory scale demo of key technologies
  - Compression near critical point
  - Develop TM components and engineering
  - Construct small-scale (~1 MW) power conversion systems to demonstrate control and system performance
  - S-CO2 heat transfer exps



S-CO2 comp. exps

S-CO2 MW PCS Development

- ***Phase 1*** *– compression near critical point exps*
- ***Phase 2*** *- unrecuperated Brayton cycle*
- ***Phase 3*** *– split flow recuperated Brayton cycle demo*



Split flow recuperated Brayton demo